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Soviet Capabilities and Intentions to Orbit Nuclear Weapons

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The Central Intelligence Agency and the intelligence organizations of the Departments of State, Defense, the Army, the Navy, the Air Force, AEC, and NSA.

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SOVIET CAPABILITIES AND INTENTIONS TO ORBIT NUCLEAR WEAPONS

THE PROBLEM

To examine Soviet capabilities and intentions to orbit nuclear weapons, probable Free World reactions to such a development, and Soviet reactions to various US responses.[1]

CONCLUSIONS

A. We have thus far acquired no evidence that the USSR plans to orbit a nuclear-armed satellite in the near term, or that a program to establish an orbital bombardment capability is at present seriously contemplated by the Soviet leadership. However, the USSR does have the capability of orbiting one or possibly a few nuclear-armed satellites at any time, and at comparatively small cost. (*Paras. 1–3, 15–16*)

B. The limitations of existing hardware and facilities are such that the nuclear weapons which the Soviets could orbit during 1963–1964 would not add significantly to their military capabilities. Currently operational Soviet ICBMs would be capable of delivering comparable payloads with greater effectiveness. (*Paras. 4–14*)

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[1] In this estimate, we concentrate primarily on multiorbit bombardment satellite systems, i.e., those designed to complete one or more revolutions of the earth prior to being detonated. We also have included, though at much abbreviated length, consideration of fractional orbit system, i.e., those designed to make less than one revolution of the earth before detonation. Although they do not follow a ballistic trajectory, fractional orbit systems are employed in a manner more closely related to that of an ICBM, and are therefore not germane to most aspects of the problem.

C. A variety of political motives, such as the desire to restore the image of the USSR as the preeminent world military power, might nevertheless impel the Soviets to orbit a nuclear weapon in the near term for demonstrative purposes. Such a move would be more likely if the Soviets were already committed to the eventual establishment of an orbital bombardment force, or if convinced that the US was so committed. However, in seeking to impress world opinion, they would also encounter a variety of adverse reactions. Awe and alarm would be accompanied by resentment and dismay, and it would be charged in many quarters that the Soviets had extended the nuclear arms race into a new, more dangerous area. The Soviets would have to consider whether it would serve their interests to risk strong US countermoves, including an ambitious US military space program, and a general intensification of the cold war. (*Paras. 17–23*)

D. On balance, it appears to us that the disadvantages would outweigh the advantages, and we therefore believe that there is less than an even chance that the USSR will orbit a nuclear weapon in the near term. Nevertheless, the Soviets may weigh the balance differently than we do, and it remains possible that they will exercise their technical capability at any time. (*Para. 24*)

E. If the USSR should orbit a nuclear weapon for demonstrative purposes, it would almost certainly anticipate some form of US reaction. The Soviets would have to consider the possibility of a US attempt to destroy their satellite, and if the US threatened to do so, they would probably threaten retaliation against US satellites. They would be wary, however, of the risks involved in direct retaliation, including a possible "open war" on all satellites and the accompanying dangers of escalation. Official and popular opinion in most states allied with the US would expect and support US measures to counter the Soviet action. Opinion in the nonaligned states would favor some form of UN "solution." The Soviets themselves might use the UN in an effort to deter US countermoves and to delay or forestall any US military program in space. (*Paras. 25–30*)

Prospects for 1965–1970

F. Based solely on considerations of cost and effectiveness as we now understand them, it would appear unlikely that the Soviets will during this decade deploy advanced orbital bombardment systems of military significance We recognize, however, that the Soviets might reach different conclusions as to cost and effectiveness, or that other factors might be more weighty. Moreover, considering the pace of developments in the weapons field in general, it is extremely hazardous to estimate Soviet decisions for a period many years ahead. For these reasons, a firm estimate as to whether the Soviets will deploy an advanced orbital bombardment system within the 1965–1970 period cannot be made at this time. (*Paras. 31–34, 45–49*)

G. If the Soviets do proceed with an advanced orbital system, we believe that they are more likely to seek a small force of limited effectiveness than a very large and sophisticated one. The weapons of a small force could be maintained continually in orbit or could be held on standby on the ground for deployment as required. In any case, developmental testing of an orbital bombardment system should be observable to us at least a year or two prior to attainment of an accurate, reliable system. (*Paras. 35–44, 50*)

DISCUSSION

I. INTRODUCTION

1. We have no direct evidence of any Soviet plan to orbit a bombardment satellite. However, we believe that the Soviets have a present and near term (1963–1964) capability to launch one or possibly a few such nuclear-armed satellites by employing existing hardware. With respect to the longer term (1965 and beyond), we are convinced that the Soviet leadership will, if it has not already, authorize feasibility studies and perhaps research and development tests on an orbital bombardment system.

2. Because of the lack of direct evidence, this estimate relies heavily on what is known of the Soviet and US states-of-the-art in the development of advanced missiles, space systems, and nuclear weapons. In employing this approach, we recognize that great uncertainties are involved, especially in the longer term. Knowledge of what is feasible and useful in the field of space weapons may change significantly as additional research and development work is performed in both countries. At present, however, the factors we can set forth with respect to Soviet capabilities for orbiting nuclear weapons include: (a) the known and theoretical capabilities of Soviet space and missile boosters if adapted to this purpose; (b) the estimated yields and effects of nuclear warheads detonated at various altitudes; (c) the techniques the Soviets might employ for orbiting and detonating such weapons; and (d) the likely accuracy, reliability, and costs of alternative techniques.

3. In considering the problem of this estimate, particularly with reference to the near term, we have sought to distinguish between the known performance characteristics and the theoretical possibilities of existing Soviet hardware and related equipment. We have, in addition, considered certain trade-offs the Soviets might also weigh, such as maximizing warhead payloads for higher yield detonations in orbit at the expense of lower altitude detonations with their greater ground effects. For the longer term, we have assumed continued Soviet development of large boosters and appropriate subsystems which could be employed for a variety of missile and space purposes, including an orbital bombardment system.

II. SOVIET CAPABILITIES TO ORBIT NUCLEAR WEAPONS, 1963–1964

Available Booster Systems

4. The USSR could use any one of several launch vehicle systems it now possesses to orbit a nuclear weapon. The system considered most

suitable for the launching of such a weapon on the basis of known performance characteristics is the SS–6 ICBM booster, with either a Lunik or a Venik upper stage. Another launch system the Soviets conceivably could utilize is the SS–8 ICBM. We have not yet been able to determine whether the SS–8 is relatively small or very large.[2] If the SS–8 is very large, it could be used in conjunction with a Venik upper stage—a combination not tested to date—to provide the Soviets with their greatest present payload capability in a nuclear-armed satellite.

5. In addition, the Soviets could theoretically put a nuclear weapon into orbit with the SS–8 ICBM if it is relatively small, with the SS–7 ICBM, or with the SS–5 IRBM. However, their orbital payload capabilities would be much less than that of the SS–6. The use of these smaller boosters would probably require the development and testing of satellite or upper stage hardware of types not now known to be available.

Warhead Yields and Effects

6. Currently available evidence shows that the Soviets are interested in individual weapons of large megatonnage yields, for deterrence and intimidation as well as for actual military employment. The weight and thus the yield of a nuclear warhead which could be orbited by a given launch system would be dependent on the altitude at which the satellite was to be orbited, on whether or not the satellite was to be deorbited prior to detonation, and on other variables.[3] The highest yields could be achieved if the warhead were detonated while in orbit, because the satellite would need to have little on-board equipment other than the warhead. Using the SS–6, with a Venik upper stage, the Soviets could achieve a yield [ ] in a weapon designed for orbiting and detonation at 100 n.m. altitude. If the SS–8 is large and was employed with the same upper stage, they might be able to attain [ ] under the same conditions.

7. Our knowledge of the effects of high-yield warheads detonated at very high or orbital altitudes is subject to much uncertainty. We are confident, however, that if [ ] were detonated at altitudes as high as 100 n.m., they would produce negligible blast, shock and fallout effects on the ground. Available data suggest that [ ] at this altitude would create heat over large areas, provided that the atmosphere was clear, but this heat would not be of sufficient intensity to start fires or to cause second degree burns to

[2] For a discussion of possible performance characteristics of the SS–8 ICBM, see NIE 11–4–63, "Soviet Military Capabilities and Policies, 1962–1967," dated 22 March 1963, TOP SECRET, paragraphs 49–56 and Annex B, Table 1.

[3] For a tabular summary of the estimated yields attainable with possible Soviet launch systems under various conditions in 1963–1964, see Table 1.

exposed human skin. Such detonations might cause temporary blackout of communications and radar over thousands of miles, but we have insufficient data at present to measure such possible effects reliably and we think it unlikely that the Soviets themselves possess such data.

8. In order to produce effects on the ground, therefore, a bombardment satellite orbited with existing hardware would have to be designed to de-orbit its warhead. In a satellite designed to be orbited at 100 n.m. and then to de-orbit and detonate its weapon at an altitude on the order of 150,000 feet, the SS–6 with a Venik upper stage could deliver a warhead capable of[ ] The SS–8, if large, and employed with a Venik upper stage, however, could still theoretically deliver a weapon with[ ]under these conditions. In clear weather, such bursts at this altitude would cause severe damage to cities and other soft targets over a fairly large area, primarily by means of fire, although blast effect could be significant against some soft targets.

9. Detonation at even lower altitudes would be required to damage soft or hard targets by means of blast, shock and nuclear radiation. This form of delivery would require heat-shielding and other on-board equipment which would further reduce the size of the nuclear payload. However, by using the SS–6/Venik, the Soviets could still orbit at 100 n.m. and bring down to several thousand feet for detonation, a weapon with a yield of[ ] If the requirement were imposed that the nuclear weapon be recoverable, this possible yield would be further reduced[ ]The SS–8, if large, and employed with a Venik upper stage, could[ ]for low altitude detonation, or [ ]if the weapon was recoverable. However, as great or greater yields could be obtained with these launch systems if employed as ICBMs; accuracy and reliability would also be better.

Other Characteristics

10. In designing a system, the Soviets would also have to consider other trade-offs between its characteristics and the nuclear payload which could be orbited with a given launch system. In the examples given above, we assumed that the Soviets would employ minimal orbital altitudes (100 n.m.) and shallow de-orbiting paths in order to maximize nuclear payload. Orbital altitudes higher than 100 n.m. would result in a longer orbital lifetime, but at the expense of payload. There would also be a trade-off between accuracy and payload. Steep de-orbiting paths would result in greater delivery accuracy, but the vehicle would require more propellant for retrorockets and thus have reduced weapon yield.

11. While we believe the Soviets are now capable of orbiting a nuclear-armed satellite without prior testing, they could not have much confidence in its reliability and accuracy as a delivery system. The deduc-

tions we have made from Soviet missile and space technology point to a technical capability of achieving a CEP on the order of 5–10 n.m. with warheads, of the yields mentioned above, de-orbited on shallow re-entry paths.[4] Soviet recoverable earth-satellites have contributed some experience in accurate de-orbiting of space vehicles, but the greater accuracy required for weapon delivery would call for developmental tests with new components. To develop such accuracy and to establish the reliability of nuclear-armed satellites would probably require a series of tests over a period of at least a year after an initial launching.

12. The effective orbital lifetime of nuclear-armed satellites the USSR could launch in the near term into 100–300 n.m. circular orbits is estimated to range from a week or so at the lower altitude to several months at the higher. The de-orbit propulsion system probably would be equally reliable at either altitude, although the longer storage period in space might have adverse effects on this system. Further, the Soviets must recognize that loss of ground control would result in eventual decay at an unpredictable point along the orbit. Therefore, they would almost certainly take precautions to build into the satellite safety devices designed to deactivate or destroy the warhead system if control of the vehicle was lost.

13. Existing Soviet facilities probably are adequate to control the operation of a single or a few nuclear-armed satellites. These facilities could readily be employed to detonate a warhead over Soviet territory or the open ocean for demonstrative purposes. The Soviets would experience few difficulties in detonating a nuclear warhead on a north to south pass over the US, since all the retrorocket ignition points fall within line-of-sight of the USSR. This would not be so on south – north passes, but a satisfactory system could probably be developed by using a timer, set while the satellite was over the USSR.

14. Based on the foregoing considerations, we judge that the USSR could orbit and detonate a nuclear-armed satellite at any time. Because of uncertainties as to its performance, the Soviets would presumably consider it no more than a dramatic demonstration of technical capabilities. If, however, a series of test launchings began in the near future, there is a possibility that by the end of 1964 the Soviets could have a small force of perhaps 5–10 nuclear-armed satellites with predictable reliability and accuracies on the order of 5–10 n.m. CEP. In addition to the necessary boosters, satellites and warheads, such a force would probably require at least some additional ground facilities, which could be constructed concurrently.

[4] As indicated above, a somewhat better accuracy could theoretically be achieved by employing steeper re-entry paths and sacrificing some payload weight, but we think this very unlikely in the 1963–1964 period.

Cost Considerations [5]

15. The Soviets could put one or more nuclear-armed satellites into orbit with present hardware, or acquire a standby capability to do so, at a cost on the order of $50 million per satellite. Assuming an effective lifetime in orbit of several months, one such satellite could be maintained in orbit at all times at a cost on the order of $100 million or more per year. Even with existing types of hardware, however, it would cost much more to develop weapons with predictable reliability and accuracy and to have a force of 5–10 such weapons in orbit at all times. To accomplish this, the Soviets would have to expend on the order of $1 billion for test firings, hardware production, ground facilities, and other initial investment. Maintenance costs would probably be some $½–1 billion per year thereafter. For purposes of comparison, total Soviet expenditures on long range attack forces of all types (bombers, ground-launched missiles, and missile submarines) are on the order of $6–6½ billion per year, excluding research and development costs.

III. LIKELIHOOD IN 1963–1964

Current Evidence

16. As indicated above, we have thus far acquired no direct evidence indicating that the USSR intends to orbit a nuclear weapon in the near term. To date, no test firings have been observed which can be identified with the development of such a weapon. We have, furthermore, no positive evidence that a program to establish an orbital weapon capability is at present seriously contemplated by the Soviet leadership. There have, however, been a number of public references by high ranking Soviet officials in the past two years with regard to the military uses of space. In these statements, they have frequently referred to "global rockets" and on a few occasions to their ability to launch rockets from orbiting satellites. Moreover, the Soviets have recently become increasingly critical of US space activities, focusing their comments on an alleged US intention to exploit space for military purposes.

Potential Advantages and Disadvantages

17. If only because of its high cost and limited effectiveness we believe it unlikely that the Soviets will deploy in the near term an orbital force which would maintain as many as five to ten nuclear weapons in orbit. They could launch one or a few such satellites at comparatively small cost, but these would have negligible military value. Thus,

[5] We have no information on the ruble costs of Soviet ICBM or space systems. All cost figures presented in this estimate represent calculations of what such weapons might cost if produced in the US.

we believe a Soviet decision to orbit nuclear weapons during the next two years or so would be based in the main on political and psychological considerations. The Soviets might conceive of such a move as a dramatic demonstration of technical and military prowess, one designed essentially to bolster their international prestige. We have pointed out elsewhere that the Cuban crisis had the effect of altering to the disadvantage of the USSR the view generally held of the balance of military power and that the Soviets have a strong incentive to restore plausibility to their claims of military superiority. They would hope that the consequent enhancement of the USSR's image as a great power could be used to persuade or intimidate other states into making concessions.

18. If, for primarily military reasons, the Soviets decide over the course of the next year or so to begin a major space weapons program for later deployment they might use an initial developmental vehicle for demonstrative purposes, hoping in this way to achieve immediate political capital. (They acted in much this way in the late 1950's when claims of a significant ICBM capability followed the decision to develop an ICBM force but preceded the deployment of such a force.) Further, whether or not the Soviets are now committed to a space weapons program, they might seek to demonstrate their own prowess first if convinced that the US was committed to such a program. They might even seek to forestall or delay the US effort by launching their own weapon in an attempt to arouse world pressure, particularly in the UN, against the militarization of space. They could plan subsequently to offer to withdraw their weapon in exchange for US adherence to a ban on space weapons.

19. Reactions in the Free World to the USSR's launching of an orbital weapon would vary with time and place, and much would depend on the extent and promptness of the US response. Reactions would also depend in part on the nature of the Soviet demonstration, on the claims advanced by Moscow concerning weapons capabilities and potential use, and on the credibility of these claims. We think it highly unlikely that the Soviets would assert that they had launched an orbital weapon without actually having done so. Their claims would have the greatest credibility if the Soviets actually detonated a weapon, but they could probably be made persuasive even in the absence of a detonation. (A test ban would presumably preclude a detonation.)

20. The orbiting of a nuclear weapon might provide the Soviets with a potent psychological weapon, a "sword of Damocles" which seemed to hang over everyone's head in a way which, logic and military technology aside, ICBMs do not. The feat would stimulate respect for

Soviet scientific excellence—though scarcely of post-Sputnik I proportions—awe of Soviet power, and fear of Soviet intentions. If the Soviets offered to remove their weapon in exchange for Western concessions, many individuals and not a few Free World governments would view the offer with relief and might urge the West to meet Soviet demands.

21. In seeking to gauge popular and official reactions in the Free World, the Soviets would also have to consider possible unfavorable responses. Though the Soviets would almost certainly characterize their move as a necessary "defensive" measure, much world opinion would view it as a new source of international tension and as a further obstacle to disarmament. It would be charged in many quarters that the USSR had extended the nuclear arms race into a new and more dangerous area, and in doing so, moreover, had placed all countries, not merely its potential enemies, in peril. In Western Europe, where the population has long lived under the Soviet threat, many would probably be receptive in time to official assertions that the orbital weapon added little or nothing to existing Soviet capabilities.

22. On balance, we do not believe that a Soviet demonstration would generate any massive or enduring shift of public sentiment. Despite the probable creation of considerable initial alarm, particularly if the Soviet move occurred during a period of high tension, pre-existing inclinations would for the most part be likely to govern both popular and governmental reactions. Among elements in the West favoring a conciliatory approach to Soviet pressures, for example, fear and concern would probably lead to mounting demands for official concessions, and resentment at the Soviet "violation" of space might be channeled more against the arms race and the cold war in general than directly against the USSR. Conversely, among those who advocate a more belligerent posture vis-a-vis the USSR, militancy would be heightened and would be accompanied by demands for some form of direct action to counter what would be regarded as a new Soviet threat.

23. Finally, in assessing the consequences of an orbital weapons demonstration, the Soviets would have to weigh the possibility that their act might stimulate a fateful turn in world affairs. They would have to consider very carefully whether it would serve their internal and international interests to risk possible strong US countermoves, a general intensification of the cold war, and an acceleration of the arms race. Specifically, if as yet uncertain as to US plans, the Soviets would be concerned that the launching of an orbital weapon for essentially political purposes might spark an ambitious US military program in space.

Near-Term Intentions

24. Thus, the specific factors likely to be involved in a Soviet decision to orbit a nuclear weapon tend either to conflict with one or another or to rest on such imponderables as the Soviet estimate as to the likelihood of a US military program in space. Further, they depend in part on the overall US posture, the international climate as a whole, and the tactical line of Soviet policy at any given time. Thus, we cannot assess with confidence the likelihood of the USSR's launching a nuclear-armed satellite in 1963–1964. On balance, it seems to us that the disadvantages would outweigh the advantages, and we therefore believe that the chances are less than even that the USSR will make such a move. Nevertheless, the Soviets may weigh the balance differently from the way we do, and it remains possible that they will exercise their technical capability at any time.

IV. REACTIONS TO SPECIFIC UN AND US COURSES OF ACTION

25. If the Soviets do in fact orbit one or a few nuclear weapons, they would probably expect some form of UN response. A UN resolution condemning the Soviet action and calling for the removal of the weapons would probably be strongly supported by all Western European and most Latin American governments. A majority of the Afro-Asian States would also probably support their removal, though many might be reluctant to support a clear-cut condemnation of the USSR. The Soviets, if willing to entertain the idea of removing their weapons, could be expected to insist on some form of *quid pro quo* from the US. In this event, they could probably count on support from many nonaligned states. The outcome would, of course, rest in part on US policy at the time and the USSR's tactics in regard not only to the issue at hand but also its foreign policies in general. We believe, however, that the chances are better than even that the UN would eventually pass some form of resolution which criticized the Soviet move and called for a permanent ban on weapons in space. It might also appeal to other powers, most notably the US, to negotiate with the USSR in an effort to secure the removal of the Soviet weapons.

26. Moscow would probably expect an appeal for the removal of its weapon. The USSR might agree to remove its weapon from orbit if the UN passed a resolution condemning any military use of space. It is more likely, however, that the USSR would counter with a broader resolution dealing with other disarmament and cold war issues, maintaining that it could not be deprived of a military advantage without some recompense from the West. Or, it might offer to withdraw its weapon in exchange for US agreement to refrain from orbiting observation satellites.

27. The Soviets would also probably allow for a direct US response. In addition to a vigorous protest, which they would almost certainly reject, they might expect the US to demonstrate a comparable capability in the minimum time possible. Moscow probably would not seek to destroy a US weapon deployed under these circumstances. An offer from the US to withdraw its weapon in exchange for similar Soviet action would probably receive considerable support from world opinion and from the UN. The Soviets might be receptive to such an exchange if it appeared at that time that their political objectives had already been well served.

28. The Soviets would have to consider the possibility of a US attempt to destroy their satellite, and if they did, there are various ways in which they could seek to avoid such a US action. They need not reveal the nature of their satellite until after detonating it. If they did reveal the nature of the satellite while in orbit, they might detonate it after only a few orbits, perhaps before it passed over US territory, thus minimizing both US reaction time and anti-satellite capabilities. The Soviets might also seek to deter US action by statements threatening some form of retaliation, such as the destruction of US satellites.

29. Whether the Soviets would in fact seek to destroy US satellites in the event that the US destroyed the Soviet weapon would depend on a number of circumstances, including the general US stance and the international climate. The USSR's response would also depend upon Soviet estimates as to the consequences of inaction in terms of its international prestige in general, and its possible plans for future space activity in particular. If the US had orbited a nuclear weapon, the Soviets would probably seek to destroy it in retaliation. If the US had not orbited a weapon, the Soviets might view the US move as providing an opportunity to frustrate any future US military activities in space; at the very least, they could cite the US actions as a precedent and threaten to destroy any future US orbital weapons. Indeed, Moscow might believe the US action provided a good pretext for the destruction of US observation satellites. The Soviets, however, would be wary of the risks involved in direct retaliation, including a possible "open war" on all satellites and the accompanying dangers of escalation.

30. Both governmental and public opinion in most allied states would expect a vigorous US response to a Soviet deployment of orbital weapons. While there might be some preference for at least an attempt to secure UN action, US measures to counter the Soviet action would in general receive firm support; indeed, US failure to act (particularly after an unsuccessful attempt to deal through the UN) would probably lead to considerable dismay. Opinion in the nonaligned states would probably be most sympathetic to efforts to achieve voluntary

grounding of the weapon by Moscow. US action to destroy the Soviet weapon would probably stimulate concern as to the consequences for world peace but—once a possible crisis had passed—probably few would view the US move as anything other than a legitimate reply to Soviet provocation. If, instead, the US launched its own nuclear weapons, the nonaligned states would probably see in the US response merely an inevitable countermove. Pressures on the US and the USSR to desist from extending the arms race into space would be strong, at least for a time.

V. SOVIET CAPABILITIES, 1965–1970

31. The Soviets will be able to improve their capabilities in bombardment satellites throughout the present decade even if they employ only the launch vehicles available today. Advances in Soviet nuclear technology would increase the yields of the warheads which could be orbited. For example, assuming continued nuclear testing, by about 1970 the SS–6/Venik combination could probably place a weapon of [redacted] into a 100 n.m. orbit for detonation at about 150,000 feet, as compared with [redacted] We also expect advances in the techniques of guidance and control in the normal course of continued Soviet ICBM and space development. Even with these improvements, however, one or a few such weapons would continue to have negligible military value.

32. Any orbital bombardment system of real military significance would require satellite vehicles in some number, and would accordingly be extremely complex and expensive. Important developmental progress toward such a system within the decade would require a major Soviet effort to perfect hardware and to develop advanced techniques. In considering whether to authorize such an effort, the Soviet leadership would examine the likely military value of orbital bombardment systems in relation to the mix of forces for long range attack they would hope to have in the late 1960's and beyond, and the costs of the alternatives open to them. Further, considerations relating to political reactions, the risk of intensifying the arms competition, and other similar factors discussed above would become even more complex and weighty in connection with such an effort.

33. Although we have only a general idea of the probable composition of Soviet long range striking forces some years hence, our present information supports an estimate of several broad trends in the future development of these forces. It appears quite likely that present Soviet schedules call for the acquisition of some hundreds of ICBM launchers for missiles with multimegaton yield warheads. Efforts to improve readiness and reaction times are evidently being carried out to increase the effectiveness of strategic attack forces for pre-emptive or retaliatory

strikes. The hardening of a portion of the land-based missile forces and the development of advanced submarine-launched missile systems point to Soviet concern to have protected retaliatory capabilities. All these developments, together with the trend toward higher megaton yields which has been evident in the nuclear testing program, are designed to enhance both the deterrent value and military capability of the Soviet striking forces.

34. None of the recent trends in the Soviet strike forces suggest, however, that the USSR presently contemplates forces capable of completely neutralizing US strike forces in an initial blow, nor do Soviet programs appear designed to match the US in numbers of delivery vehicles. Thus far, the Soviets appear to be counting on continued deployment of their large and reliable missiles and on the added threat provided by the testing of very high yield weapons to attain credibility for their deterrent. We think, therefore, that they would be likely to view the development of orbital bombardment systems primarily as a means of supplementing their existing types of forces in this role rather than visualizing such weapons as replacement or substitute systems. They would probably also consider them as one way of introducing additional complications into US defense planning. Finally, they would probably regard them as a qualitative advance in weapon technology which could support Soviet claims to parity or even superiority in total strategic capabilities.

Technical Considerations

35. There is a wide range of delivery techniques and types of orbital forces which might be sought by the Soviets, with considerable difference in developmental requirements, costs, and effectiveness. Because we have no direct evidence of Soviet objectives in the field of orbital bombardment systems, we can examine Soviet capabilities only in terms of the broad alternative types of forces the USSR might consider as supplementary strike systems. In all cases, we have assumed that the Soviets' evident interest in very high yield systems would lead them to consider orbital vehicles capable of carrying warheads with yields of at least 25 megatons, and preferably 100 megatons or more.

36. For employment in the period beyond 1965, the Soviets could consider several broad types of multiorbital bombardment force, each of them capable of providing a continuous and visible threat of attack on US and other Western targets. To provide a threat of retaliation against population centers, they might find a relatively small force with limited effectiveness sufficient. For such a force, hardened command and control facilities would be required, but near-simultaneity of weapon delivery would not be essential, nor would precise accuracy be needed with very high yield warheads. For pre-emptive employment

against smaller or harder military targets, however, a sophisticated force with high accuracy, short times to target, and near-simultaneity of weapon delivery would be necessary.

37. Some possible characteristics of representative forces of these two broad types, and estimated Soviet capabilities to achieve them are discussed in the following paragraphs. In general, however, because of present uncertainties as to the effects of nuclear weapons detonated at altitudes above the dense atmosphere, a desirable feature of any orbital system under present consideration (other than a token force) would be a capability to detonate weapons at whatever altitude was later found to be most effective. In addition, the orbiting vehicles would need to be long-lived and reliable, and to be protected against countermeasures. Finally, factors of safety and cost would probably dictate the incorporation of techniques to recover warheads within Soviet territory.

38. *A force of limited effectiveness* might be designed to maintain a small number of weapons in orbit, which, while they would not provide continuous target coverage would be capable of detonation on specified targets over a period of hours as their orbits passed near. A representative force of this type might be programmed eventually to maintain some 10–25 weapons in orbit at altitudes of several hundred miles, able to attack targets within a few hundred miles of their orbital planes. The Soviets would probably consider CEPs of 5–10 n.m. adequate for this purpose. To carry warheads of 100 MT or more which could be detonated at any altitude or recovered, the system would require advanced spacecraft weighing on the order of 20 tons. To orbit such vehicles, the Soviets would need to employ a new, large booster with a thrust of 1½–2 million pounds.[6] If such a booster becomes available for flight testing as early as 1964, and is adapted to an orbital bombardment system, it is possible that weapons of this size and weight could be orbited in the 1965–1967 period. Further testing over a period of a year or two after the initial launching would be required to establish accuracy and reliability.

39. Such a force could be deployed and maintained in orbit with relatively few launching facilities, and it might even utilize facilities constructed for other purposes, although some additional control facilities probably would be required. If the Soviets pursued development and deployment of such a limited force, we think they could have it fully operational by 1970.

40. *A very sophisticated force,* on the other hand, might be designed to maintain a large number of weapons in carefully spaced orbits, with guidance and control capable of programming weapons against a spe-

[6] For a discussion of Soviet large booster development, see paragraphs 27–33 of NIE 11–1–62, "The Soviet Space Program," dated 5 December 1962, SECRET.

cified target system within minutes of a decision to attack. A representative force of this type might eventually be programmed to maintain some 80–200 weapons in orbit at all times so as to be able to attack some 10–25 targets in the US with 100 MT warheads over a period of an hour or two. Such a force would need to employ very advanced spacecraft with precise on-board attitude control and retrorocket systems, and with side-ranging capabilities to attack targets several hundred miles from their orbital planes with CEPs approaching one n.m. Decoys and other measures to reduce vulnerability and mask the size and location of the force would be highly desirable.

41. The attainment of a force of this sort would require major Soviet advances in technology as well as a large-scale program to produce hardware and construct ground facilities. It is possible that the required spacecraft could be developed and proved out within the 1967–1970 period. In addition, however, a sophisticated force of this type would need to have numerous launching facilities, a very complex computation and control facility, and a substantial number of tracking and command stations spaced symmetrically across the USSR at the highest possible latitudes. Although the establishment of such a force could be in progress beginning as early as 1967, it seems highly unlikely, in view of the enormous complexities involved, that it could be fully operational until after 1970.

42. *Alternative systems* of a variety of types might be developed. For example, a somewhat smaller booster system could be employed to orbit spacecraft with advanced performance but weighing less than the vehicle required to deliver 100 MT weapons. If the SS–8 booster is large, and development of an advanced spacecraft is already underway, an initial developmental launching of [ ] could probably occur in 1965.

43. It is also possible that a multiorbit bombardment force could be designed as a standby force, with some reduction in total vehicle requirements below those of a force of weapons in orbit at all times. Such a force would have its weapons stored at ground complexes, ready for launching at any time. If a standby force was intended solely for deployment during periods of international tension, hardening of ground facilities would not be necessary. On the other hand, if a retaliatory role was also assigned to a standby force, hardening of most if not all facilities probably would be required. A small standby force, with perhaps 10–25 weapons available for launching, might appeal to the Soviets as an alternative to a small multiorbit force which maintained the same number of equivalent weapons in orbit. As a practical matter, one launcher probably would be needed for each 2–4 standby weapons, so that launching of the entire force could be accomplished in a period of a few days. A large standby force of sophisticated weapons would

not be a practicable alternative to a similar force maintained in orbit, primarily because of the exorbitant requirement for launch facilities.

44. Finally, we estimate that the Soviets are also capable of developing a fractional orbit [7] bombardment system within the 1965–1970 time period. A system of this type would be designed to launch weapons at the initiation of hostilities in a manner comparable to that of ICBM systems, but on near-global trajectories in an effort to avoid US warning systems. Fractional orbit weapons with yields ranging from 25 to 100 or more megatons could be developed with hardware comparable to that of multiorbit systems. Development time for the spacecraft could be somewhat shorter because on-board systems would be less complex. However, such a system would need very extensive and complex ground facilities, which could take at least as long to construct as those of a very sophisticated multiorbit force.

Considerations of Cost and Effectiveness

45. It is impossible to make any confident estimate about what sort of orbital bombardment system the Soviets are likely to develop, or even whether they will commit major resources to develop any such system. Indeed, it seems likely that they have not yet proceeded beyond the point of feasibility studies on advanced orbital bombardment systems, and of weighing the possible costs and effectiveness of such systems against those of other delivery systems capable of performing comparable missions.

46. The costs of orbital systems would depend on their size and sophistication, but in all cases they would be quite large when compared with ICBM costs. Rough calculations based on US experience suggests that the very sophisticated orbital system which we have described would require R&D expenditures on the order of $2–3 billions. To establish and maintain a force of some 80–200 vehicles in orbit at all times would cost $4–12 billions for initial investment and an equal amount annually thereafter for the life of the program, even assuming that the vehicles had an average orbital lifetime of 1 year. The force of limited effectiveness, with some 10–25 weapons continually in orbit, would probably require R&D expenditures of some $2 billions, an initial investment on the order of $½–1½ billion and an equal amount annually thereafter. This smaller force, however, even if its R&D costs were minimal, would over a five-year period cost more than five times the amount required to deploy and maintain for the same period an equal number of large, hardened ICBMs with 100 MT warheads.

[7] A fractional orbit system is one which is designed to make less than one revolution of the earth before detonation, but which does not follow a ballistic trajectory.

47. A small, unhardened force, maintained on a standby basis, would be much less expensive than a force maintained in orbit. After an initial investment on the order of $½ to $1½ billion, operating costs could be as little as 100 million dollars annually, a portion of which would be expended to conduct one or two reliability and confidence firings. Even so, such a force would be more costly than an equivalent ICBM force. It seems likely that the Soviet leadership would have to be well convinced of the value of an orbital system before making such a large commitment.

48. For accomplishing military missions, we think that during the 1965–1970 period, orbital bombardment systems will not compare favorably with ICBMs in terms of reaction time, average life, reliability, vulnerability, accuracy, or targeting flexibility. In addition to being less effective militarily, an orbital bombardment system will be considerably more costly than an equivalent delivery capability with ICBMs. Based solely on considerations of cost and effectiveness as we now understand them, therefore, it would appear unlikely that the Soviets will during this decade deploy advanced orbital bombardment systems of military significance.

49. We recognize, however, that the Soviets might reach different conclusions as to cost and effectiveness, or that other factors might in their view be more weighty. It is possible that the Soviet leaders would be strongly attracted by what an orbital bombardment system might do to reverse the impression that they are now inferior in strategic capabilities. Moreover, considering the pace of developments in the weapons field in general, it is extremely hazardous to estimate Soviet decisions for a period many years ahead; it is possible that the rapid progress of space technology could result in weapons developments whose feasibility is not now manifest. It is also possible that the Soviets are deferring a decision while awaiting more information on their own technical progress as well as on US capabilities and intensions with respect to military space programs. For these reasons, a firm estimate as to whether the Soviets will deploy an advanced orbital bombardment system within the 1965–1970 period cannot be made at this time.

50. If the Soviets do proceed with an advanced orbital system, we believe that they are more likely to seek a small force of limited effectiveness than a very large and sophisticated one. The weapons of a small force could be maintained continually in orbit or could be held on standby on the ground for deployment as required. In any case, developmental testing of an orbital bombardment system should be observable to us at least a year or two prior to attainment of an accurate, reliable system.

Table 1

WARHEAD WEIGHTS AND YIELDS OF POSSIBLE SOVIET NUCLEAR-ARMED SATELLITES, 1963–1964 [a]

LAUNCH SYSTEM [b]	NON-RECOVERABLE PAYLOAD FOR DETONATION IN ORBIT	NON-RECOVERABLE PAYLOAD FOR DETONATION ABOVE 150,000 FT.		NON-RECOVERABLE PAYLOAD FOR DETONATION AT ANY ALTITUDE		RECOVERABLE PAYLOAD FOR DETONATION AT ANY ALTITUDE	
		90° Range Angle [c]	30° Range Angle [c]	90° Range Angle [c]	30° Range Angle [c]	90° Range Angle [c]	30° Range Angle [c]
Orbital Altitude of 100 Nautical Miles							
SS–6, with Lunik upper stage [d]	9,100 lbs/	7,200 lbs/	4,700 lbs/	5,700 lbs/	4,000 lbs/	5,400 lbs/	3,300 lbs/
SS–6, with Venik upper stage [d]	13,700 lbs/	11,100 lbs/	7,400 lbs/	9,100 lbs/	6,400 lbs/	8,700 lbs/	5,400 lbs/
SS–8, if large [e]	15,300 lbs/	12,500 lbs/	8,500 lbs/	10,200 lbs/	7,300 lbs/	9,700 lbs/	6,200 lbs/
SS–8, if large, with Venik upper stage [e]	23,000 lbs/	19,000 lbs/	12,500 lbs/	15,000 lbs/	11,000 lbs/	14,000 lbs/	9,300 lbs/
Orbital Altitude of 300 Nautical Miles							
SS–6, with Lunik upper stage [d]	8,200 lbs/	6,300 lbs/	3,300 lbs/	4,800 lbs/	2,700 lbs/	4,600 lbs/	2,000 lbs/
SS–6, with Venik upper stage [d]	12,300 lbs/	9,700 lbs/	5,300 lbs/	7,800 lbs/	4,500 lbs/	7,500 lbs/	3,600 lbs/
SS–8, if large [e]	13,900 lbs/	11,000 lbs/	6,000 lbs/	8,800 lbs/	5,100 lbs/	8,400 lbs/	4,100 lbs/
SS–8, if large, with Venik upper stage [e]	21,000 lbs/	16,500 lbs/	9,000 lbs/	13,200 lbs/	7,500 lbs/	12,500 lbs/	6,000 lbs/

[a] The megatonnage yields for nuclear devices of weights equivalent to those used in this table are expected to be higher in the post-1965 period. For example, while in 1963–64 a nuclear warhead weighing about 5,400 pounds could deliver a device with [redacted] a warhead of the same weight could in 1970–1972 deliver a device with [redacted] assuming continued nuclear testing.

[b] In addition, the Soviets could theoretically put a nuclear weapon into orbit with the SS–8 ICBM, if it is relatively small, the SS–7 ICBM or the SS–5 IRBM. However, even with upper stages, their orbital payload capabilities would be much less than that of the SS–6, and in some cases would be extremely limited even under optimum conditions. Further, it would probably require the development and testing of satellite hardware of types not now available.

[c] The use of a 90-degree range angle for de-orbiting provides for greater warhead weight at the expense of accuracy. Conversely, a 30-degree range angle would result in a lighter warhead but a better CEP. These two values represent reasonable maximum and minimum range angles in this time period. A 300-nm side range capability during de-orbiting has been assumed so as to provide some targeting flexibility.

[d] Tested and proven satellite launch system.

[e] For a discussion of possible performance characteristics of the SS–8 ICBM, see NIE 11–4–63, paragraphs 49–56 and Annex B, Table I. The SS–8 has not yet been tested in a satellite-launching role nor has it yet been tested in combination with the Venik upper stage.

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